

Mortality among Homeless and Nonhomeless Mentally Ill Veterans

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This study directly compared mortality risk in homeless and nonhomeless mentally ill veterans and compared mortality rates in these groups with the general U.S. population. The study used a retrospective cohort design to assess mortality over a 9-year period in homeless ($N = 6714$) and nonhomeless ($N = 1715$) male veterans who were treated by Department of Veterans Affairs specialized mental health programs. The study showed that mortality rates in all homeless members of the cohort were significantly higher than the general U.S. population. Relative to nonhomeless cohort members, significant increases in mortality risk were observed in cohort members who at baseline were age 45 to 54 and had been homeless 1 year or less ($RR = 1.55$, 95% $CI = 1.02, 2.36$) and those age 55 and older who had been homeless 1 year or less ($RR = 1.83$, 95% $CI = 1.33, 2.52$). Similar, but nonsignificant trends were observed in cohort members who had been homeless more than 1 year at baseline. Additionally, medical problems at baseline and history of prior hospitalization for alcohol problems elevated mortality risk. Employment at baseline and minority group membership reduced mortality risk. The study suggests that mentally ill veterans served by specialized VA mental health programs are at elevated risk of mortality, relative to the general population. Homelessness increases this risk, particularly in older veterans, and this difference does not abate after entry into a health care system.

— *J Nerv Ment Dis* 188:141–147, 2000

(3) May

Homelessness is a devastating condition associated with chronic exposure to the elements and impaired access to health services (Robertson and Cousineau, 1986). There are relatively few studies, however, of the association between homelessness and mortality. These few studies have found greater death rates in homeless cohorts relative to the general population (Barrow et al., 1999; Hibbs et al., 1994; Hwang et al., 1997). Greater mortality in homeless individuals is not unexpected, as the prevalence of severe poverty, substance abuse, and psychiatric and medical problems tends to be higher among homeless individuals than in the general population (Fischer and Breakey, 1991). Additionally, homelessness may increase the exposure of these individuals to situations resulting in violence or injury (Jahiel, 1992).

Although it is probable that substance abuse and psychiatric and medical problems play a role in the elevated mortality among the homeless, no empirical demonstration of these relations exists. Moreover, because previous studies only compared mortality among the homeless with mortality in the general population, there has been no assessment of the impact of homelessness on mortality that takes these comorbidities into consideration.

The purpose of the current study was to investigate the effect of homelessness on mortality risk in individuals with mental illness, using a retrospective cohort design. Two types of comparisons were conducted: a) mortality rates of homeless cohort members were compared to rates in the general U.S. population and b) mortality rates of homeless and nonhomeless cohort members (all of whom used VA mental health services) were compared, using baseline information to control for several sociodemographic and clinical characteristics related to mortality.

Methods

Cohort

The cohort for this study was composed of veterans treated by two specialized Department of Veterans Affairs (VA) mental health programs, the homeless chronically mentally ill veterans (HCMV)

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The ongoing operation of the VA specialized mental health programs in this study proceeds under the guidance of Dr. Thomas Horvath, Dr. Lawrence Lehmann, and Ms. Gay Koerber of the Department of Veterans Affairs Mental Health Strategic Healthcare Group. Funding for the program evaluation also comes from the Department of Veterans Affairs. We thank Mr. Dennis Thompson and Mr. Donald Showalter for assistance with data management.

TABLE 1
Baseline Demographic and Clinical Characteristics of Surviving and Deceased Cohort Members

Variable	Non-Homeless				Short Duration Homeless				Long-Duration Homeless			
	Survivors (N = 1549)		Decedents (N = 166)		Survivors (N = 4139)		Decedents (N = 774)		Survivors (N = 1530)		Decedents (N = 271)	
	N	Mean or %	N	Mean or %	N	Mean or %	N	Mean or %	N	Mean or %	N	Mean or %
Age (mean + SD)	1,549	45.5 ± 8.3	166	49.2 ± 11.9	4,139	43.9 ± 8.3	774	50.6 ± 11.5	1,530	44.8 ± 8.4	271	50.2 ± 10.3
35-44	1,075	69.4	95	57.2	2,802	67.7	326	42.1	932	60.9	106	39.1
45-54	270	17.4	26	15.7	811	19.6	152	19.6	351	22.9	66	24.4
55+	204	13.2	45	27.1	526	12.7	296	38.2	247	16.1	99	36.5
African-American	289	18.7	36	21.7	1,674	40.8	218	28.4	565	37.3	69	25.9
Hispanic	223	14.4	12	7.2	195	4.8	34	4.4	69	4.6	9	3.4
Caucasian	1,003	64.8	112	67.5	2,178	53.1	531	66.7	860	56.8	184	69.2
Other	34	2.2	6	3.6	54	1.3	4	0.5	21	1.4	9	1.5
Employed full or part-time	791	51.2	57	34.3	1,610	41.6	203	27.9	344	24.0	52	21.1
Married	808	52.2	69	41.6	217	5.6	38	5.2	31	2.2	4	1.6
Combat experience	1,488	97.1	160	97.0	1,594	38.7	301	39.1	558	36.6	113	41.9
Current alcohol abuse	391	25.3	56	33.7	1,938	46.8	400	51.7	779	51.0	143	52.8
Previous hospitalization for alcoholism	456	29.5	80	48.2	2,057	49.7	456	58.9	780	51.0	162	59.8
Current drug abuse	209	13.5	30	18.2	1,034	25.0	124	16.0	346	22.6	42	15.5
Previous hospitalization for drug dependency	228	14.7	29	17.6	1,074	26.0	150	19.4	363	23.7	48	17.7
Current psychiatric problems	1,480	95.7	159	95.8	1,769	45.4	322	44.1	689	47.5	110	44.5
Previous hospitalization for psychiatric problems	525	39.6	57	40.7	1,456	35.2	262	33.9	531	34.7	80	29.5
Service connected psychiatric problems	523	33.8	58	34.9	274	6.6	56	7.2	76	5.0	13	4.8
Medical problems	829	53.6	104	62.7	1,890	46.1	495	64.7	784	51.9	186	69.1
Service connected medical problems	668	43.1	70	42.4	516	12.5	122	15.8	155	10.1	35	12.9

Groups differ ($p < .05$) on all measures except age.

program, which provides comprehensive outpatient mental health services, housing assistance, and case management (Rosenheck et al., 1989), and the post-traumatic stress disorder clinical teams (PCT) program, which treats veterans with posttraumatic stress disorder on an outpatient basis (Fontana et al., 1991). The majority of the participants in these programs reported psychiatric or substance abuse problems, and an appreciable percentage had prior hospitalization for such problems (see Table 1). Three study groups were formed. Two groups consisted of male veterans age 35 and older who were literally homeless (living in a shelter or having no residence) at the time of first contact with the HCMI program during 1989 and 1990. One of these groups had been homeless for up to 1 year before program entry ($N = 4913$); the other had been homeless for more than one year prior to program

entry ($N = 1801$). The third study group consisted of male nonhomeless (living in their own apartment, room or house at the time of program entry) veterans age 35 and older who were treated by the PCT program during the same time period ($N = 1715$).

Baseline Measures

Demographic and clinical characteristics at baseline were collected through an interview conducted at time of entry to both programs by trained staff clinicians. The HCMI and PCT interviews were not identical but contained several common items that were used for the present study. Demographic characteristics included age, gender, ethnicity, marital status, military history, and employment situation. Mental health information included self-reported alcohol, drug, and general psychiatric problems as

well as service-connected psychiatric problems (*i.e.*, those determined to be related to military service). Previous hospitalizations for substance abuse and psychiatric problems were reported. Self-reported medical problems and service-connected medical problems were also recorded.

Mortality Data Collection

Mortality was determined from dates of death in the Beneficiary Identification Records Locator Subsystem (BIRLS) data base. The BIRLS is a VA administrative data base used to record payments of several types of benefits, including death benefits. The BIRLS has been shown to provide reliable mortality information for veterans (Fisher et al., 1995). Program entry records for the study cohort were merged with records containing vital status information by matching social security numbers. The merge of program entry records (from 1989 and 1990) with the BIRLS data base was conducted in January 1998; thus, the longest follow-up period for a cohort member was approximately 9 years.

Data Analysis

Years of follow-up (survival time) for each member of the cohort was defined as the time between date of program entry and the date of death or end of the follow-up period (date of database merge). Crude mortality rates for each group (per 100,000 person-years) were formed by dividing the number of deaths by years of follow-up and multiplying by 100,000.

Analysis of survival time was conducted using proportional hazards regression. The main independent variable was homeless status at program entry (not homeless, homeless less than 1 year [short duration], homeless greater than 1 year [long duration]). Age at program entry was included as a categorical variable (age 35 to 44, age 45 to 54, age 55 and over). Preliminary inspection of unadjusted mortality rate ratios suggested an interaction between homelessness and age; therefore, four interaction variables were included in the model (these were product terms of the homeless status and age category variables). In addition to these main variables of interest, covariates in the final model included: minority ethnicity (African-American, Hispanic or other, Caucasian), employment (full or part time), previous hospitalization for alcohol problems and current medical problems. All non-continuous variables were coded using the reference cell method (Kleinbaum et al., 1988). These covariates were selected from a larger set based on

statistical significance ($p < .05$) after backward selection procedures.

Finally, standardized mortality rates (SMRs) were constructed for the six cohort groups formed by combinations of age (35 to 54 and 55+) and homelessness at baseline (none, short-duration, and long-duration). Mortality rates for males in the United States in each age category published by the Centers for Disease Control and Prevention were used in calculation of number of expected deaths in each group (CDC Wonder internet site). Ninety-five percent confidence intervals for the SMRs were constructed using the short-cut method described by Vandenbrouke (1982).

Results

Demographic and Clinical Characteristics at Baseline

Table 1 displays several demographic and clinical characteristics of surviving and deceased cohort members, listed by homelessness status. The age distribution of the two groups was similar; however, the homeless group contained more members of ethnic minority groups, especially African-Americans. The nonhomeless group contained a higher percentage of veterans who were employed, who were married, and who were exposed to combat. The nonhomeless group also had a higher percentage of veterans who reported psychiatric and medical problems, particularly service connected problems. These differences are expected because virtually all of the members of the nonhomeless group had posttraumatic stress disorder (PTSD). In contrast, the homeless group contained a higher percentage of veterans who reported alcohol and drug problems, as well as previous hospitalizations for these problems.

Comparison of Cohort Mortality with U.S. Population

Consistent with previous studies, SMRs showed that the mortality rate in homeless members of the cohort were significantly higher than the mortality rate of males in the United States. Specifically, the SMR (and 95% CI) for short-duration homeless veterans age 35 to 54 was 4.20 (3.81, 4.61), and for long-duration homeless veterans in this age category, it was 4.13 (3.29, 4.83). Short-duration homeless veterans age 55 and older had an SMR of 1.69 (1.51, 1.87). Long-duration homeless veterans in this age category had an SMR of 1.40 (1.16, 1.66). The SMR for nonhomeless cohort members age 35 to 54 was also significant, 3.16 (2.61, 3.76). The SMR for nonhome-

TABLE 2
Crude Mortality Rates by Age at Baseline and Homelessness

Age (yr)	Homelessness	N	Deaths	Person-years of Follow-Up	Mortality (per 100,000 person-years)	Rate Ratio ^a	95% CI ^b	
							Lower Limit	Upper Limit
35-44	None	1170	95	7316.5	1298.4			
35-44	Short-duration	3128	326	21,921.3	1487.1	1.15	0.91	1.44
35-44	Long-duration	1038	106	7250.7	1461.9	1.13	0.85	1.48
Subtotal		5336	527	36,488.5	1444.3			
45-54	None	296	26	1848.0	1406.9			
45-54	Short-duration	963	152	6190.7	2455.3	1.75	1.15	2.65
45-54	Long-duration	417	66	2,767.2	2385.1	1.70	1.08	2.67
Subtotal		1676	244	10,805.9	2258.0			
55+	None	249	45	1360.5	3307.7			
55+	Short-duration	822	296	4282.5	6911.9	2.09	1.53	2.87
55+	Long-duration	346	99	1858.0	5328.3	1.61	1.14	2.30
Subtotal		1417	440	7501.0	5865.9			
All ages	None	1715	166	10,524.9	1577.2			
All ages	Short-duration	4913	774	32,394.5	2389.3	1.51	1.29	1.80
All Ages	Long-duration	1801	271	11,876.0	2281.9	1.45	1.20	1.76
Overall		8429	1211	54,795.4	2210.0			

^aReference is mortality rate in the nonhomeless group within each age category.

^bEstimated using unadjusted proportional hazards regression.

less veterans age 55 and older, however, was not significant, .92 (.68, 1.20).

Cohort Mortality Rate Comparisons

Table 2 presents unadjusted mortality rates and rate ratios for the study cohort by age and homelessness category. Overall, the mortality rates in this cohort were quite high: 2,210 per 100,000 person-years of follow up. (The mortality rate in the United States for males 35 and older is 1,586 per 100,000.) As would be expected, mortality rates increased substantially in the older age categories, with the oldest veterans (aged 55 and older) having rates more than 4 times that of the youngest age group (aged 35 to 44). Mortality rates of the homeless groups are higher than those of the nonhomeless within each age category. The unadjusted rates also suggest an interaction between homelessness and age: the rate ratio of homeless versus nonhomeless increases at each age category, from 1.15 (short duration) and 1.13 (long duration) in the youngest age group to 2.09 (short duration) and 1.61 (long duration) in the oldest.

Table 3 shows the results of the proportional hazards regression model of mortality risk in this cohort. Like analysis of the unadjusted rates, the multivariate model shows that mortality rates increase with age: veterans aged 55 and older had significantly higher rates than the reference group of veterans aged 35 to 44 (chi-square [1 df] = 19.35,

$p = .0001$). The intermediate age category (age 45 to 54) did not differ from the youngest group.

The effect of homelessness on the risk of mortality was not uniform across age categories; rather, the impact of homelessness varied across age and duration categories. Short-duration homelessness significantly increased risk of mortality only in the oldest members of the cohort, indicated by the significant interaction term for homelessness and age 55 and older (chi-square [1 df] = 5.87, $p = .0154$). Risk ratios constructed to compare short-duration homeless versus nonhomeless veterans in each age category demonstrate nonsignificant increases in risk of 13% in the 35 to 44 age category, and significant increase in risk of 55% in the 45 to 54 age category (RR = 1.55, 95% CI = 1.02, 2.36) and 83% in the 55 and older age category (RR = 1.83, 95% CI = 1.33, 2.52). A trend toward the same age-related pattern of results was seen in the long-duration homeless groups; however, the 28% increase in mortality risk in the 45 to 54 age group and 41% increase in the 55 and older age group (relative to their nonhomeless counterparts) failed to reach statistical significance.

Survival functions from life table analyses for the age and homelessness groups in the study are presented in Figure 1. This graph shows that there was a decreasing probability of survival for all groups across the follow-up period, with the lowest probability occurring in the two age 55 and over homeless groups. The functions suggest an absence of major

TABLE 3
Adjusted Risk Ratios for Mortality from Multivariate Analysis

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	P	Risk Ratio	95% CI	
							Lower Limit	Upper Limit
Age 45-54	1	0.050	0.222	0.05	.8219	1.05	0.68	1.62
Age 55+	1	0.804	0.184	19.13	.0001	2.24	1.56	3.20
Short-duration homeless (age 35-44)	1	0.119	0.119	1.00	.3181	1.13	0.89	1.42
Long-duration homeless (age 35-44)	1	-0.011	0.148	0.01	.9425	0.99	0.74	1.32
Short-duration homeless \times age 45-54 ^a	1	0.321	0.244	1.72	.1895	1.55	1.02	2.36
Long-duration homeless \times age 45-54 ^a	1	0.255	0.279	0.83	.3620	1.28	0.80	2.04
Short-duration homeless \times age 55+ ^a	1	0.485	0.200	5.87	.0154	1.83	1.33	2.52
Long-duration homeless \times age 55+ ^a	1	0.355	0.234	2.30	.1296	1.41	0.98	2.03
Minority	1	-0.209	0.066	10.01	.0016	0.81	0.71	0.92
Employed	1	-0.257	0.071	13.16	.0003	0.77	0.67	0.89
Hospitalization for Alcohol Problems	1	0.370	0.062	35.30	.0001	1.45	1.28	1.64
Medical Problems	1	0.461	0.065	50.85	.0001	1.59	1.40	1.80

^aParameter estimates, standard errors and chi-squares are from the model interaction terms; risk ratios and 95% CIs were calculated using nonhomeless veterans within each age category as the reference group.

shifts in mortality risk during the follow-up period, despite entry of these veterans into treatment.

The multivariate analysis controlled for several important additional influences on mortality risk. Previous hospitalization for alcohol problems significantly increased the risk of mortality (RR = 1.45, 95% CI = 1.28, 1.63) as did medical problems at the time of program entry (RR = 1.58, 95% CI = 1.39, 1.79). In contrast, full-time or part-time employment reduced mortality risk (RR = .79, 95% CI = .68, .90). Minority ethnicity was also protective with respect to mortality risk in this cohort (RR = .81, 95% CI = .71, .92).

Discussion and Conclusions

The goals of this study were to compare mortality in our cohort of homeless veterans to the general population and then to conduct a more controlled assessment of mortality risk by comparison of mortality rates in homeless veterans to mortality rates of nonhomeless veterans who also sought VA mental health services. The first set of comparisons replicates the findings of previous studies (Barrow et al., 1999; Hibbs et al., 1994; Hwang et al., 1997) showing higher mortality rates in homeless individuals relative to the general population. The second set of analyses, which controlled for several sociodemographic and clinical characteristics, showed that short-duration homelessness significantly increased risk of mortality in older members of the cohort, but not in younger members. A similar, though nonsignificant age-related trend was observed in the long-duration homelessness condi-

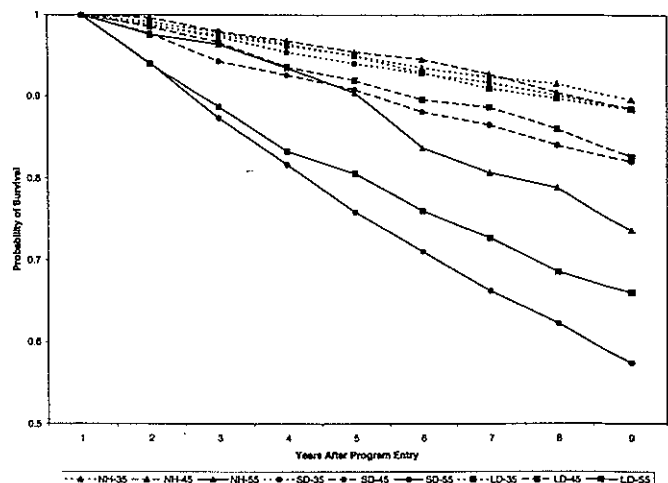


FIG. 1 Survival functions for age and homelessness groups. NH = not homeless (triangles); SD = short-duration homeless (circles); LD = long-duration homeless (squares). Age 35 to 44 (dotted lines); age 45 to 54 (solid lines).

tions. To our knowledge, the current study is the first to document the role of homelessness in mortality risk using an explicit comparison group of nonhomeless cohort members with similar health problems.

The comparison of mortality rates in the cohort to the population of males in the United States aids interpretation of within-cohort findings. Specifically, the mortality rate of younger nonhomeless cohort members was significantly higher than the general population, whereas the mortality rate of older nonhomeless cohort members was not. Thus, the relatively smaller impact of homelessness at younger

ages seen in our within-cohort comparisons was due in large part to higher-than-average mortality rates in younger nonhomeless cohort members. Although not homeless, these veterans did have appreciable psychiatric and medical problems, which may have contributed to their high rates of mortality. This finding clearly underscores the importance of using an explicit comparison condition in the analysis of mortality rates in the homeless.

There was no clear relationship between duration of homelessness at baseline and risk for mortality in the current study. The tendency was for increased mortality risk in the short-duration homeless groups within each age category. In contrast, Barrow et al. (1999) found a positive relation between "extended homelessness" and subsequent mortality risk. Information regarding housing status at baseline in the current study asked only about current homelessness, rather than lifetime homelessness. This may have reduced sensitivity of the study to relation between duration of homelessness and mortality (*e.g.*, if many of our short-duration homeless group members had appreciably higher lifetime histories of homelessness). Alternatively, it is possible that long-duration homeless individuals who had severe medical, psychiatric, or substance abuse problems may have been referred to more intensive services than those offered by the HCMI program or may have died before being contacted and thus were not included in the study cohort. Unfortunately, there is no way to document the impact of this potential selection bias on current results.

A second unexpected finding was that the difference in mortality risk between homeless and nonhomeless veterans did not diminish over the course of the nine-year follow-up period, despite treatment by specialized services (see Figure 1). This may imply that the processes increasing mortality risk in homeless veterans are not substantially altered by specialized services. However, analyses addressing actual services received and mortality risk are necessary before any conclusions regarding this finding are possible.

The mortality rates of the homeless members of the study cohort (2,389 deaths per 100,000 person-years in the short-duration group and 2,282 deaths per 100,000 person-years in the long duration group) were somewhat higher than the rate of 1,496 per 100,000 person-years in homeless men age 35 to 74 observed by Hibbs et al. (1994), but slightly lower than the rate of 2,625 per 100,000 person-years in homeless men of the same age range found by Barrow et al. (1999). Rates in all of these studies are substantially higher than the rates observed in the general U.S. population.

The multivariate regression analysis used in the current study allowed the concurrent assessment of several influences on mortality over and above age and homelessness. The increase in mortality risk associated with medical problems at time of program entry and the protective effect of being employed at time of entry are not unexpected. The association of prior hospitalization for alcohol problems may be due to this measure serving as a proxy for severity of alcohol problems. The association of chronic alcoholism and mortality is well documented (Institute of Medicine, 1990). The reduced risk for mortality for ethnic minorities in this cohort was also not unexpected. Several studies of minorities in VA homeless programs have shown better social adjustment in minority homeless veterans relative to nonminorities (Rosenheck et al., 1997; Rosenheck and Fontana, 1996; Rosenheck and Seibyl, 1998). This may be due to the greater prevalence of poverty in minorities making homelessness a more normative condition.

Limitations of the current study must be noted. The first concerns potential confounders with homelessness in the current study which limits attribution of observed differences to homelessness only. Although our homeless and nonhomeless groups were composed of patients in VA specialized mental health programs, they differed in the types of problems for which they were being treated (*e.g.*, the nonhomeless group had higher percentages of veterans with PTSD, and previous psychiatric hospitalizations as well as lower percentages of veterans with alcohol problems and previous hospitalizations for alcohol problems). The current analyses controlled for all statistically significant group differences on baseline characteristics; yet, residual confounding from these variables (or from characteristics not measured) may have influenced our results. It should also be noted that the covariates in the current study were simple yes/no measures gathered by veteran self report. It is possible that more detailed information (*e.g.*, specific medical and psychiatric diagnoses abstracted from medical records) would have strengthened the explanatory power of the current analyses. A second limitation concerns the source of mortality information used in the current study. The BIRLS has been shown to be comparable to the National Death Index (the current "gold standard") with respect to mortality ascertainment in a general veteran population (Fisher et al., 1995). However, its relative accuracy within a homeless population is not known. If the BIRLS is less sensitive to mortality among the homeless (*e.g.*, because the burial benefit may be less likely to be claimed in this group), the influence of homeless-

ness on mortality in the current study would be underestimated. A third limitation is that housing status of the cohort was recorded only at baseline. It seems likely that a change in housing status during the follow-up interval (*i.e.*, homeless cohort members obtaining housing or nonhomeless cohort members losing housing) would influence subsequent mortality. However, it should be noted that such changes in housing status would tend to work against the observation of greater mortality in the homeless.

Additional questions regarding mortality in this cohort remain. First, analyses of potential differences in cause of death between homeless and nonhomeless veterans should be conducted. Second, the intensity and type of services used by the members of this treatment-seeking cohort, and their relation to mortality requires study. The use of a nonhomeless comparison group affords several advantages for studies of mortality in the homeless.

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